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ABSTRACT

This paper reports an industrial information specialist's experience in performing online searches for engineers and surveys the databases used. Engineers seeking assistance fall into three categories: (1) those who recognize the value of online retrieval; (2) referrals by colleagues; and (3) those who do not seek help. As more successful searches for colleagues are performed this latter category tends to decline. Information searching for engineers requires patience, cost consciousness, and a facility to meet short time frames for urgently required information. Databases most commonly used at Exxon Research and Engineering Company are Compendex, APILIT, CA Search, and NTIS. Rationale for their use, desirable features, and professional experiences with each are provided in short annotations, and similar data are provided for ten lesser used databases. Patent searches are explored through the use of World Patents Index, APITAT, Chemical Abstracts, and IFI Claims. Copies of transparencies used in the presentation of the paper are appended. (RAA)

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SEARCHES CONDUCTED FOR ENGINEERS

by

Patricia Lorenz

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Searches Conducted for Engineers

Online retrieval of published information for engineers has presented me with the greatest challenge of my career in information retrieval and analysis. My experience has been that many undergraduate engineers are unfamiliar with obtaining information from the published literature beyond reading a few journals every month.

The engineers that I have worked with generally fall into three categories:

1. Those who recognize the value of online retrieval either because of their training, or involvement in research projects which require a literature search, or because of successful experience with online searching.

2. Those who approach an information specialist because of the recommendation of a colleague. These engineers often know very little about the published literature in general and online searching in particular.

3. Those who never seek help from an information specialist at all.

The number of engineers in the last group should decline as more successful searches are done for their colleagues. I have already noticed such a decline in my two years of searching for engineers. Online retrieval for engineers requires more than technical competence in searching; it also requires patience, the abiity to sell online services, and the ability to teach and explain the value of the published literature to the uninitiated.

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I should point out that my contact with engineers at Exxon has been in the following disciplines: chemical, mechanical, metallurgical, civil, electrical, and marine, with particular emphasis on the petroleum refining and petrochemical industries.

The kinds of requests that we receive from our engineers fall roughly into the categories shown on Slide 1. I will be dealing here solely with technical questions and will not consider the many questions we receive, for example, from our project management or cost and scheduling groups.

The first category in Slide 1 includes full literature searches in preparation for new research projects. The number of these kinds of searches is on the increase reflecting the greater realization of the need for basic industrial engineering research. Other smaller-scale projects are also included in this category. This could include obtaining information for equipment or process modification or optimization.

Data points we are asked to find include physical or thermodynamic properties of chemicals or petroleum fractions, operating conditions for a particular process or piece of equipment, or properties of materials of construction.

The last category on slide 1 represents a large proportion of the searches we conduct for engineers. These are the "Help" searches. These requests often need immediate attention. They include corrosion problems, equipment failure, catalyst fouling or other process difficulties, or pollution problems. These requests challenge the ingenuity of the information specialist. Often the engineer has come to us as a last resort. When such a request is made, we often must drop everything, learn as much as possible about the problem in a short period of time, and then "wing it." This is no time for leafing through manuals trying to devise a sophisticated search strategy. Because we receive so many of these requests it is extremely important that we thoroughly understand the databases we search.

Another very important factor that affects search strategy in engineering questions is cost. Engineers are, by the nature of their discipline, project oriented. Many engineers assigned to a specific project have a limited amount of funds available. Consequently, they may not approach an information specialist at all, or, if they do, they put severe restrictions on the amount of money we can charge to their project. The result is that we often have to be very cognizant of cost-effectiveness in online searching. Being cost conscious requires that I use all my searching skills to the utmost. I often need to plan a strategy in the one database that I think will afford the most relevant references. Consequently, my knowledge of subject matter of databases is critical.

Because engineers often want only a few pertinent references in answer to a search request, an optimum approach to searching means a thorough screening of the printout. Engineers seem, at least in my experience, to have even less patience with false drops than do research scientists. We try, when possible, to track down the articles that will answer an engineer's request and give them to him/her instead of a printout. I have found that this approach enhances our PR with our requesters and also cuts down on the number of irrelevant requests for documents that reach our library.

Engineering Databases

The multidisciplinary nature of engineering requires searching a large number of databases. The "big four" for us at Exxon are Compendex, APILIT, CA Search, and NTIS as shown on Slide 2.

Compendex

The workhorse of searching the engineering literature is Compendex (Engineering Index). Engineering Index began in 1884. It is available online from 1970 to date. The quality and comprehensiveness of Engineering Index's coverage has made it one of the world's outstanding technical secondary literature sources. It's multidisciplinary coverage includes not only the classical engineering fields, but also the process industries and management. Compendex provides worldwide coverage of the journal literature, publications of engineering societies and organizations, conference proceedings, and selected government reports and books.

Compendex's abstracts are both searchable and printable. Index terms are single words or multiword Main Headings or Subheadings assigned from the controlled vocabulary "Subject Headings for Engineers" or single word or multiword free language terms assigned from the author's text. Free text searching can also be carried out on titles.

Card-A-Lert codes enable a searcher to limit a search by subject category. This is a very useful searching tool.

APILIT

Files available from the American Petroleum Institute provide information for engineers working in the petroleum refining and petrochemical fields. The APILIT and APIPAT files are those most heavily used by us in searching for engineers at Exxon's Florham Park Information Center. Online coverage goes back to 1964, corresponding to the birth of the API literature and patent abstracting bulletins.

All aspects of engineering relevant to the petroleum refining and petrochemical industries are covered in the API databases. Coverage includes unit operations, petroleum and petrochemical processes, equipment design and operation, properties of refinery construction materials, corrosion, process control and instrumentation, transportation and storage, and air and water pollution. Source documents include trade journals, technical journals, meeting papers, government reports, and patents.

Abstracts are available on APILIT from January 1978 to date. The API is considering loading earlier abstracts online. Abstracts, titles, and supplementary terms are not directly searchable but are stringsearchable.

Index terms selected from the API's controlled thesaurus must be used in searching the API databases. A significant amount of training and experience is necessary before a searcher can achieve competence in searching these databases. The use of API's hierarchical controlled thesaurus results in high

retrieval from the API databases. Relevance is often low because of the large number of terms used to index a document. However, relevance can be improved by the use of major index terms, links and roles, or by stringsearching.

CA Search

CA Search covers a more limited portion of the engineering field. Emphasis is on chemical, petroleum, metallurgical, nuclear, and environmental engineering as these disciplines relate to the chemical industry. Coverage in these areas is extremely comprehensive. Source documents include technical journals, patents, reviews, technical reports, monographs, technical proceedings, and dissertations.

Abstracts are not available on the CA files. Index terms can be single word and multiword subject terms from a controlled vocabulary corresponding to the CA General Subject Index Headings or free language terms derived from index modifiers and keyword phrases. Titles are searchable by free language.

Specific retrieval by compound is possible on the CA files by use of registry numbers, unique numbers assigned by Chemical Abstracts to chemical elements or compounds. CA Section numbers are also searchable as category codes. If properly used, these codes are very useful to increase the relevance of retrieval.

NTIS

The NTIS database is a multidisciplinary file of citations to U.S. Government sponsored research and development technical reports from over 200 Federal agencies. Coverage in all engineering fields is very comprehensive.

Abstracts are printable but not searchable on Dialog, and stringsearchable on ORBIT (NTIS is loaded on ORBIT only back to 1970). Free language searching usually results in fairly good retrieval. However, expert searching requires the use and understanding of the various controlled vocabularly thesauri used by contributing government agencies in indexing NTIS reports. Even so, the inconsistencies of indexing NTIS documents challenge the capabilities of even the most sophisticated searcher.

Major index terms correspond to the subject index entry terms in the printed Government Reports Announcements and Index. Other free language terms have been assigned to documents indexed by DOD, ERIC, and NTIS. COSATI (Committee on Scientific and Technical Information) and NTIS subject category codes are also searchable.

Other Engineering Databases

Some of the more specialized engineering oriented databases are listed in slides 3 and 4.

Tulsa provides worldwide coverage of the literature and patents related to the exploration, development, and production of oil and natural gas. Coverage includes geology, drilling, recovery methods, transportation and storage, environmental considerations, and alternate fuels and energy sources. Subject coverage complements the API databases; searching techniques are similar.

ISMEC (Information Service in Mechanical Engineering) covers over 250 international technical journals, conference proceedings, and books in mechanical engineering, production engineering, and engineering management. It is the only online service devoted exclusively to mechanical engineering.

Abstracts are not available on ISMEC. Descriptors are subject terms taken from a controlled vocabulary (ISMEC Subject Index Headings list). I have found ISMEC's subject coverage to be somewhat limited even within the mechanical engineering field. However, it is a useful file to search in conjunction with Engineering Index.

INSPEC provides worldwide coverage of physics, electrical and electronic engineering, and computer and control technology. Source documents include journals, conference proceedings, technical reports, books, patents, and theses. Patent coverage has, unfortunately, been recently discontinued.

Documents covered by INSPEC are technical in nature and are of interest to electrical and electronic engineers and engineers working in the computer and control areas. Coverage of computer process control is excellent. INSPEC is a quality database of great usefulness.

Abstracts are printable and searchable on Dialog's File 13, and are directly searchable on ORBIT. Index terms are subject terms from the controlled vocabulary Inspec Thesaurus or free text terms taken from the title and/or abstract. Category codes are searchable on INSPEC. Different codes are applied depending on their source, i.e., Physics, Electrical and Electronics, Computer and Control.

Metadex provides comprehensive coverage of the international literature on the science and practice of metallurgy. Source documents are international journals, conference papers, reviews, technical reports and books. Metadex is an excellent source of information for engineering, properties, and uses of metals and alloys.

Abstracts are not available on Metadex. Descriptors are subject terms from a controlled vocabulary (ASM Thesaurus of Metallurgical Terms). Since the beginning of 1974, the Alloys Index has been included in Metadex records. Alloys Index designations are searchable in the identifier field or the prefix AI= field. Other classification systems for alloys are searchable as class code or class name.

World Aluminum Abstracts covers all aspects of the aluminum industry except mining, and includes aluminum production and extraction, metal forming and working, fabrication and finishing, metallurgy, engineering properties, tests, and end uses. Sources for the database include journals, patents, government reports, conference proceedings, dissertations, and books.

Abstracts are searchable and printable. Descriptors are subject terms that are assigned to the original document. The Thesaurus of Aluminum Technology is the subject authority list. Also assigned as descriptors are terms designating commercial alloys or alloy classes, and chemical symbols. Subject category codes are also searchable.

Weldasearch covers the international literature on all aspects of the joining of metals or plastics. Welded design, welding metallurgy, fatigue, and fracture mechanics are included as well as related areas such as metal spraying and thermal cutting. Source documents include journals, books, patents (mostly U.K.), theses, conference papers, and company technical brochures. Weldasearch appears to be an excellent technical database for this specialized subject area.

Abstracts are searchable and printable. Descriptors are assigned from the International Welding Thesaurus.

MRIS (Maritine Research Information Service) Abstracts covers maritine transportation including ship construction and operation, safety and damage control, port and harbor design, and pollution and control. Sources include governmental agencies, research institutions, consultants, industries that produce maritime reports, and periodicals. I have found the file to be useful for information on tanker construction and safety, harbor design, and environmental considerations.

Oceanic Abstracts covers the international literature on scientific research and engineering studies on marine topics. Specific subject areas of interest to engineers are: physical and chemical oceanography, marine pollution, offshore engineering, ships and shipping, engineering, and materials. Source material includes journals, books, conference papers, government reports, and trade publications. Our usage of this database is similar to that of MRIS, although their document coverage differs.

SAE Abstracts covers papers given at Society of Automotive Engineers conferences. Subject coverage includes vehicle safety, materials and structures, and testing and instrumentation, as they relate to automobiles and other self-propelled vehicles.

Safety Science Abstracts covers general safety, industrial or occupational safety, environmental and ecological safety, and medical safety. International document sources include periodicals, government reports, conference proceedings, books, dissertations, and patents.

Slide 5 lists some other multidisciplinary databases which also contain coverage of the engineering fields.

Nothing more will be said on environmental databases or subject coverage beyond listing those we use most (Slide 6). Engineering for pollution control is a very large and important area, but it is beyond the scope of this paper to cover the field in any depth.

Patents as Information for Engineers

The patent art contains a significant body of information of importance to engineers. My experience has been that engineers are not as aware of this fact as they should be. It is my job as an information professional to suggest a patent search to engineers when I think the subject is appropriate.

Patents contain useful technological information in many engineering areas as outlined in slides 7 and 8. In addition to containing sound engineering information, patents also represent a means of following competitive technology. In this discussion, I am deliberately limiting myself to patents as a source of technical information and will not discuss the legal aspects of patent searching.

The major databases we use at Exxon for patent searching are shown in slide 9.

The World Patents Index (WPI) of Derwent Publications Ltd., is an outstanding file for comprehensive and timely patent coverage of more than 25 countries (15 countries receiving full coverage). WPI covers all the engineering subject areas listed on slides 7 and 8. Derwent patent coverage began for pharmaceuticals in 1963. Agricultural chemicals were added in 1965, polymers in 1966, and the rest of chemically-related technology in 1970. Nonchemical patents were added during 1974. Thus, to all intents and purpose, engineering coverage in the Derwent files begins in 1970 with chemical, petroleum, and metallurgical engineering; coverage of the other engineering fields begins in 1974.

This is not the place to discuss strategy for searching the WPI database. Suffice it to say that it is extremely complicated, and in the non-chemical areas, difficult to obtain high relevance along with good retrieval. Nonetheless, the Derwent file is an excellent source of technological engineering patent information. I would be lost without it.

Subject coverage of the APIPAT database is essentially the same as that discussed earlier for APILIT. It is an excellent file for searching petroleum-related engineering patent technology. From 1964 to 1972 all patent abstracting and indexing for the API patent bulletins was done by the American Petroleum Institute. Since 1972, abstracts from Derwent's Central Patent Index have formed the bulk of API's patent coverage. Only patents from 9 countries are indexed.

In many cases of searching the patent art in the petroleum and petrochemical-related engineering fields, APIPAT is sufficient and has the advantage of using API's controlled subject thesaurus as opposed to Derwent's more difficult searching "handles."

Chemical Abstracts engineering patent coverage is confined primarily to the field of chemical engineering and related technology. Country coverage is over 25, with primary coverage of from 6 to 17 countries depending on the time period.

The IFI Claims files cover U.S. patents only. Claims covers "chemical" patents back to 1950--this category includes all patents in the Chemical section of the Official Gazette (O.G.) of the U.S. Patent office together with any patents in the general, electrical, and mechanical sections of the O.G. which are considered to be chemically oriented.

From 1971-1977, the Claims/U.S. Patents file contains all patents listed in the general, chemical, electrical, and mechanical sections of the O.G. Claims/U.S. Patent Abstracts provides abstracts from 1978 to date.

Some other databases that contain engineering patent information are listed in slide 10.

The points I have tried to make in this paper are highlighted in slide 11. Information retrieval for engineers is in many ways similar to that for research scientists. Many of the databases used and search strategies and techniques are the same for both, but it is important to understand the differences in order to effectively supply engineers with the information they need.

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SLIDE 1

CATEGORIES OF TYPICAL SEARCH REQUESTS FROM ENGINEERS

- STATE OF THE ART TECHNOLOGY
  - FULL LITERATURE SEARCH IN PREPARATION FOR NEW RESEARCH PROJECT
  - BACKGROUND INFORMATION TO ASSIST IN SPECIFIC PROJECT
- DATA POINTS
  - CHEMICAL PROPERTIES
  - PROCESS OR EQUIPMENT OPERATING CONDITIONS
- PROBLEM SOLVING
  - EQUIPMENT FAILURE
  - ENVIRONMENTAL PROBLEMS

SLIDE 2

THE "BIG FOUR" OF ENGINEERING DATABASES

DATABASE	PRINTED EQUIVALENT	YEARS COVERED	ENGINEERING SUBJECT COVERAGE
COMPENDEX	ENGINEERING INDEX	1970 TO DATE	ALL ASPECTS OF ENGINEERING
APILIT	API ABSTRACT BULLETINS	1964 TO DATE	ENGINEERING AS APPLIED TO PETROLEUM REFINING AND PETRO-CHEMICAL INDUSTRIES
CA SEARCH	CHEMICAL ABSTRACTS	1967 TO DATE	PRIMARILY CHEMICAL ENGINEERING
NTIS	GOVERNMENT REPORTS ANNOUNCEMENTS AND INDEX	1964 TO DATE	ALL ASPECTS OF ENGINEERING THAT HAVE RESULTED IN GOVERNMENT CONTRACTS

SLIDE 3

SPECIALIZED ENGINEERING ORIENTED DATABASES

DATABASE	PRINTED EQUIVALENT	YEARS COVERED	ENGINEERING SUBJECT COVERAGE
TULSA	PETROLEUM ABSTRACTS	1965 TO DATE	PETROLEUM EXPLORATION AND ENGINEERING
ISMEC	ISMEC BULLETIN	1973 TO DATE	MECHANICAL ENGINEERING
INSPEC	PHYSICS ABSTRACTS ELECTRICAL AND ELECTRONIC ABSTRACTS COMPUTER AND CONTROL ABSTRACTS	1969 TO DATE	ELECTRICAL ENGINEERING COMPUTERS AND CONTROL
METADEX	METALS ABSTRACTS ALLOYS INDEX	1966 TO DATE	METALLURGY
WORLD ALUMINUM ABSTRACTS	NONE	1968 TO DATE	AL METALLURGY

SLIDE 4

MORE SPECIALIZED ENGINEERING ORIENTED DATABASES

DATABASE	PRINTED EQUIVALENT	YEARS COVERED	ENGINEERING SUBJECT COVERAGE
WELDASEARCH	NONE	1967 TO DATE	WELDING OF METALS AND PLASTICS
MRIS ABSTRACTS	MRIS ABSTRACTS	1970 TO DATE	MARITIME ENGINEERING
OCEANIC ABSTRACTS	OCEANIC ABSTRACTS	1964 TO DATE	MARINE RESEARCH AND OCEANOGRAPHY
SAE ABSTRACTS	NONE	1965 TO DATE	AUTOMOTIVE ENGINEERING
SAFETY	SAFETY SCIENCE ABSTRACTS JOURNAL	1975 TO DATE	SAFETY SCIENCE

SLIDE 5

SOME OTHER DATABASES CONTAINING ENGINEERING INFORMATION

DATABASE	PRINTED EQUIVALENT	YEARS COVERED	SUBJECT COVERAGE
CONFERENCE PAPERS INDEX	CONFERENCE PAPERS INDEX	1973 TO DATE	SCIENTIFIC AND TECHNICAL
COMPREHENSIVE DISSERTATION ABSTRACTS	DISSERTATION ABSTRACTS INTERNATIONAL AMERICAN DOCTORAL DISSERTATIONS COMPREHENSIVE DISSERTATION INDEX	1861 TO DATE	MULTIDISCIPLINARY
SCISEARCH	SCIENCE CITATION INDEX	1974 TO DATE	SCIENCE AND TECHNOLOGY

SLIDE 6

ENVIRONMENTAL DATABASES

APILIT
APIPAT
COMPENDEX
NTIS
ENVIROLINE
POLLUTION ABSTRACTS
APTIC
AQUATIC SCIENCES AND FISHERIES ABSTRACTS
CA SEARCH
OHM-TADS
TOXLINE
RTECS
MRIS
OCEANIC

SLIDE 7

ENGINEERING SUBJECTS FOUND IN PATENTS

CHEMICAL OR POLYMER PROCESSES AND APPARATUS

- REACTION CONDITIONS
- OPERATION AND DESIGN

UNIT OPERATIONS

TRANSPORTATION AND STORAGE

PETROLEUM PROCESSING

REFINERY ENGINEERING

CHEMICAL ENGINEERING

- SEPARATION
- MIXING, CRUSHING
- HEAT TRANSFER AND REFRIGERATION
- FURNACES

NUCLEAR REACTOR ENGINEERING

ENVIRONMENTAL ENGINEERING

SLIDE 8

ENGINEERING SUBJECTS FOUND IN PATENTS - II

METALLURGY

- METAL WORKING AND FORMING
- SOLDERING, WELDING
- METALLURGY OF IRON AND STEEL

MECHANICAL

- TRANSPORTATION AND CONSTRUCTION
- MECHANICAL ENGINEERING

ELECTRICAL

- INSTRUMENTATION, COMPUTING AND CONTROL
- ELECTRICAL ENGINEERING
- COMMUNICATIONS ENGINEERING

SLIDE 9

MAJOR DATABASES COVERING THE PATENT ART IN ENGINEERING

DATABASE	YEARS COVERED	ENGINEERING SUBJECT COVERAGE
WORLD PATENTS INDEX (DERWENT)	VARIES BY SECTION ENGINEERING COVERAGE BEGAN IN 1970	ALL ASPECTS OF ENGINEERING
APIPAT	1964 TO DATE	ENGINEERING AS APPLIED TO PETROLEUM REFINING AND PETROCHEMICAL INDUSTRIES
CA SEARCH	1967 TO DATE	PRIMARILY CHEMICAL ENGINEERING
CLAIMS/CHEM	1950-1970	CHEMICAL ORIENTATION
CLAIMS/U.S. PATENTS	1971 TO DATE	ALL ASPECTS OF ENGINEERING

SLIDE 10

SOME OTHER DATABASES WITH ENGINEERING PATENT INFORMATION

INSPEC
WELDASEARCH
WORLD ALUMINUM ABSTRACTS
APTIC
NTIS
POLLUTION ABSTRACTS
TULSA

SLIDE 11

SUMMARY

- VALUE OF ONLINE SEARCHING IS NOT ALWAYS RECOGNIZED
- ENGINEERS' NEEDS ARE OFTEN URGENT
- COST EFFECTIVENESS IS AN IMPORTANT FACTOR IN SEARCHING
- FEW GOOD REFERENCES ARE OFTEN ENOUGH
- MULTIDISCIPLINARY NATURE OF ENGINEERING REQUIRES SEARCHING MANY DATABASES
- PATENTS CONTAIN VALUABLE INFORMATION